# VBARMS: A variable block algebraic recursive multilevel solver for sparse linear systems

Liao, Jia

# Proposition/Stellingen

Jia Liao

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1. Preconditioning plays a very vital role in developing efficient solvers for difficult matrices in scientific computing.

2. One problem with current preconditioning technology is the lack of robustness and time construction scalability for solving indefinite and/or nonsymmetric problems. The thesis shows that blocking can often help to reduce iterations and speed up the preconditioner construction on modern computer architectures.

3. The development of a new variable block algebraic recursive multilevel solver (VBARMS) is presented, which detects automatically block structures in the linear system and exploits this information efficiently. Experiments are reported to illustrate that VBARMS can achieve good robustness and high throughput during the construction.

4. Different graph compression techniques for blocking the system are discussed and compared, such as the checksum method proposed by Ashcraft, the parameterized block ordering algorithm by O'Neil and Szyld, the angle method by Saad. A novel graph compression algorithm that finds approximate dense blocks structures is introduced and tested.

5. A Zoltan-based graph partitioning strategy that applies a parallel partitioner to the distributed quotient graph is able to generate communication-minimized and load-balanced distributed linear systems.

6. For large-scale turbulent flow matrices, the combination of a Zoltan-based graph partitioning strategy and parallel VBARMS shows very good convergence and scalability on multi-core supercomputers.